

Draft  
May 2005

# HydroSHEDS

Global river network and  
watershed delineation  
at 90m resolution based  
on SRTM elevation data



Global  
SRTM  
derivatives  
for  
hydrological  
applications  
at multiple  
scales

Bernhard Lehner

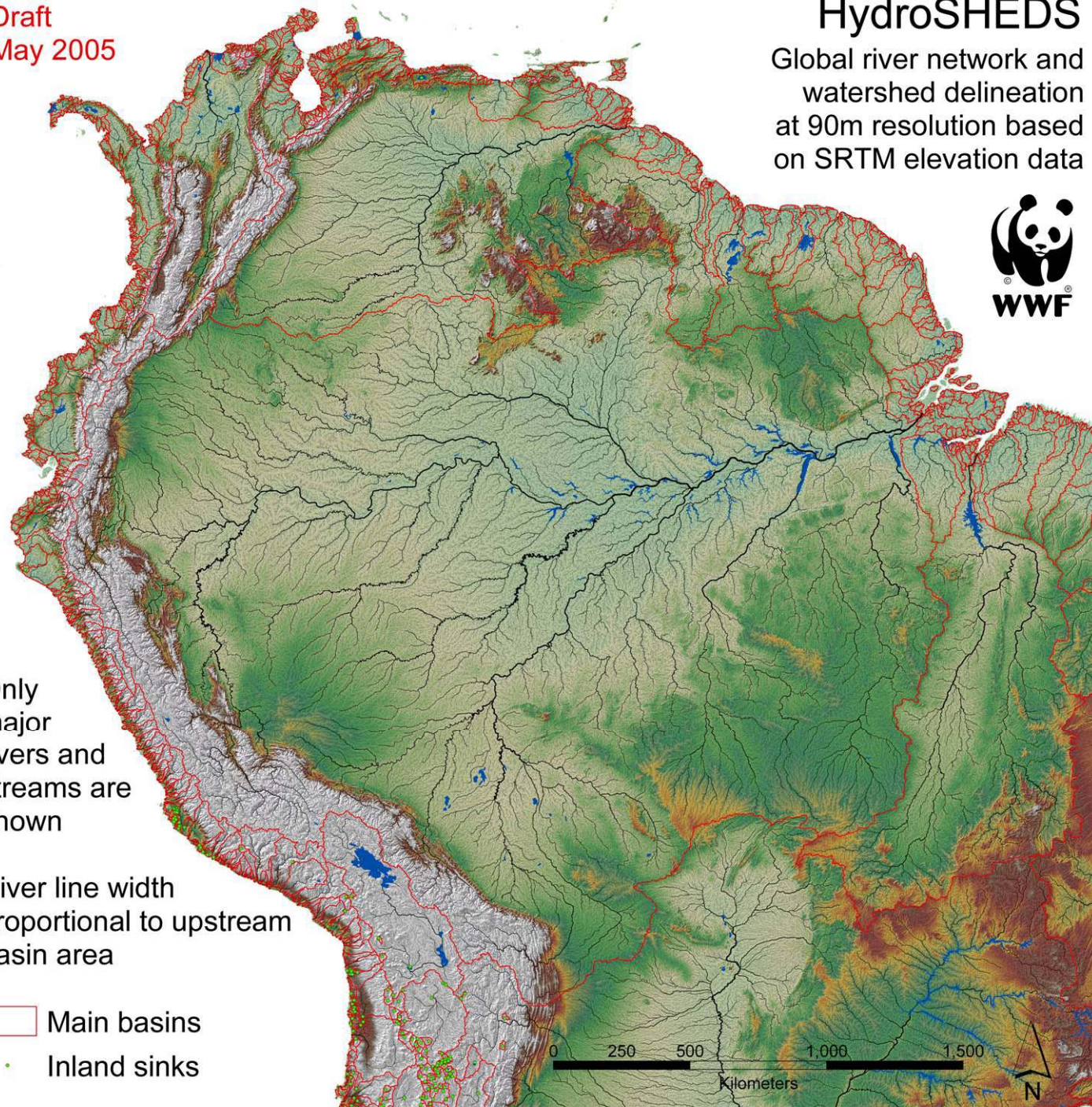
World Wildlife  
Fund US

in collaboration  
with The Nature  
Conservancy,  
CIAT, USGS

Only  
major  
rivers and  
streams are  
shown

River line width  
proportional to upstream  
basin area

□ Main basins  
• Inland sinks



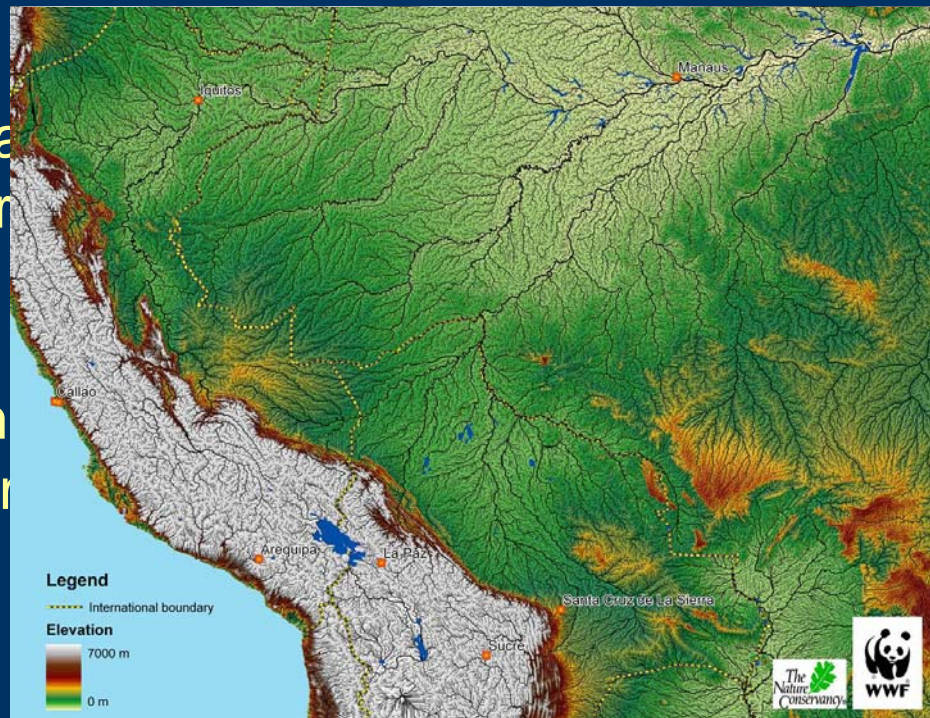


# HydroSHEDS

Hydrological data and maps

based on Shuttle Elevation Derivatives at multiple Scales

- Project goal:  
Derive large-scale digital river network and basin maps as key input layers for watershed analyses and hydrological applications
- Existing products like the global (1 arc-minute resolution) or regional maps are not available or their seamless extent
- SRTM provides for the first time a global DEM at near-global extent, from which river networks can be derived

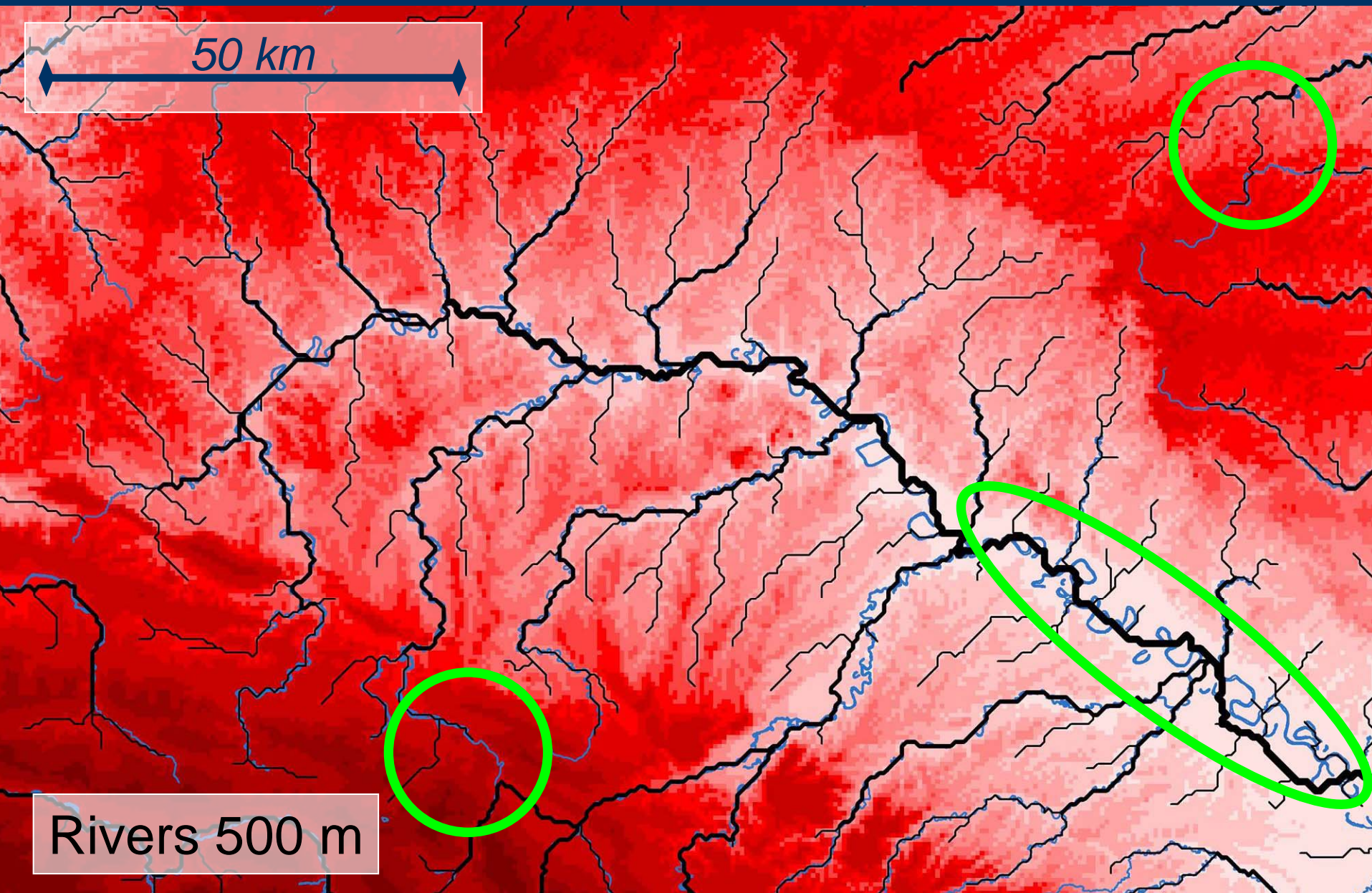


“Useful” resolutions:

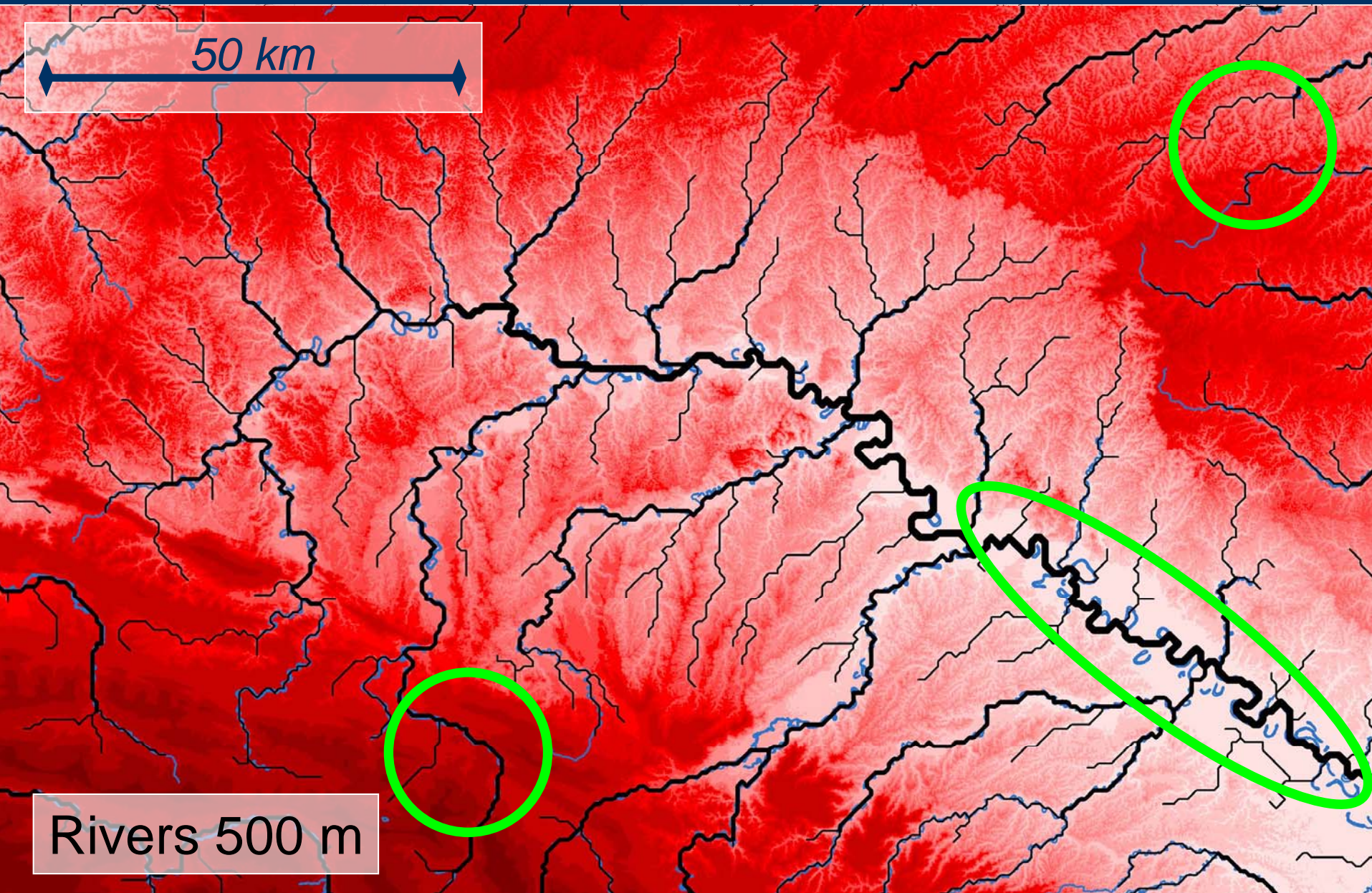
- ~ 500 m for large basins and continents
- ~ 1 km for the globe

- Option 1: First upscale SRTM elevation data, then derive flow directions
  - 😊 fast and easy
  - 😞 low quality
- Option 2: First derive flow network at high resolution, then upscale this network
  - 😊 maximum information is preserved
  - 😞 deriving flow network at 90 m resolution is very laborious
- 😊 HydroSHEDS applies option 2, adding the advantage that it also provides results at 90 m resolution (while still focusing on large scale products)









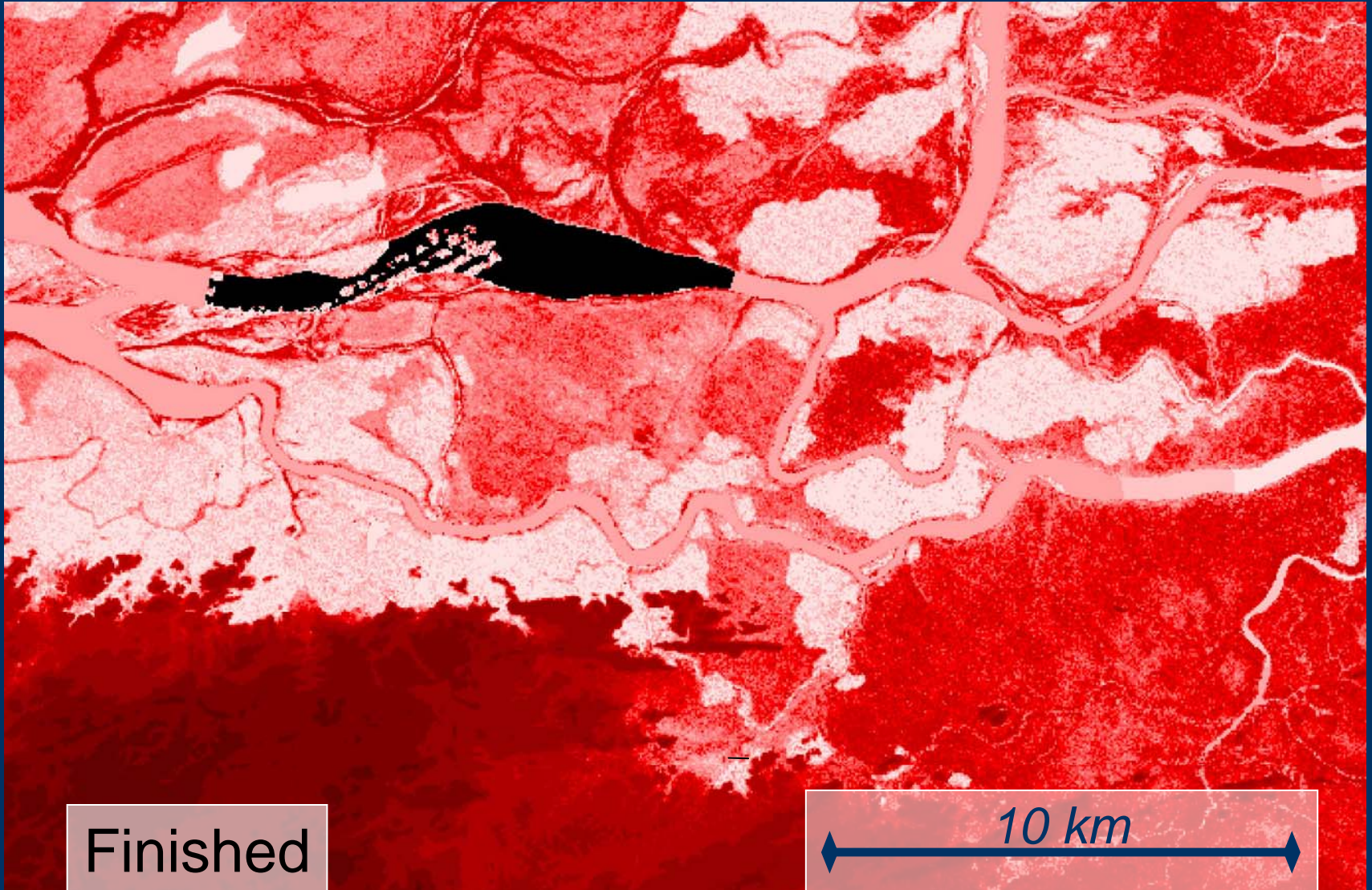


# Main processing steps

- SRTM data preparation
- Void filling
- Sink identification
- Hydrologic conditioning
- Upscaling

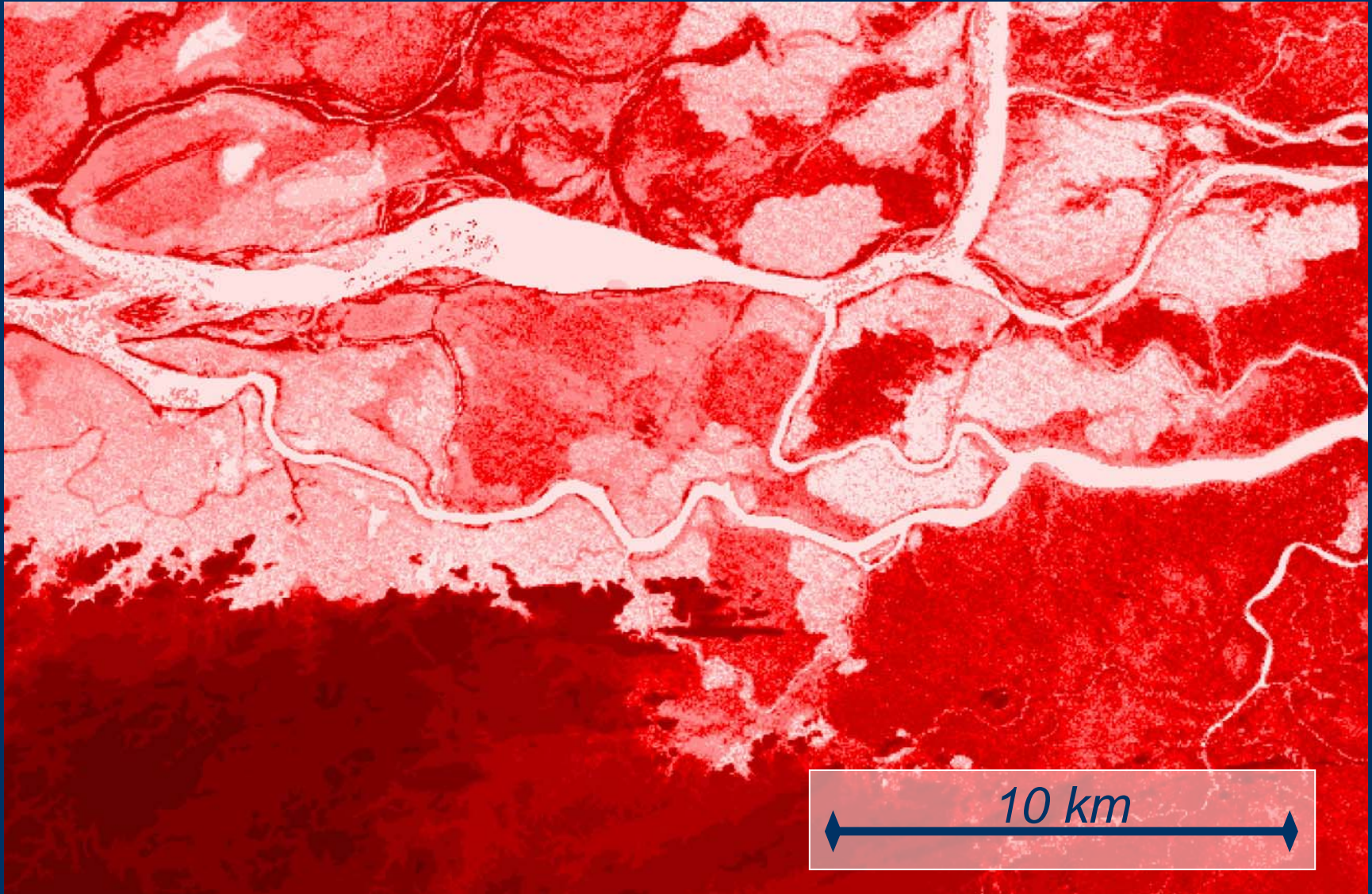


# SRTM data preparation





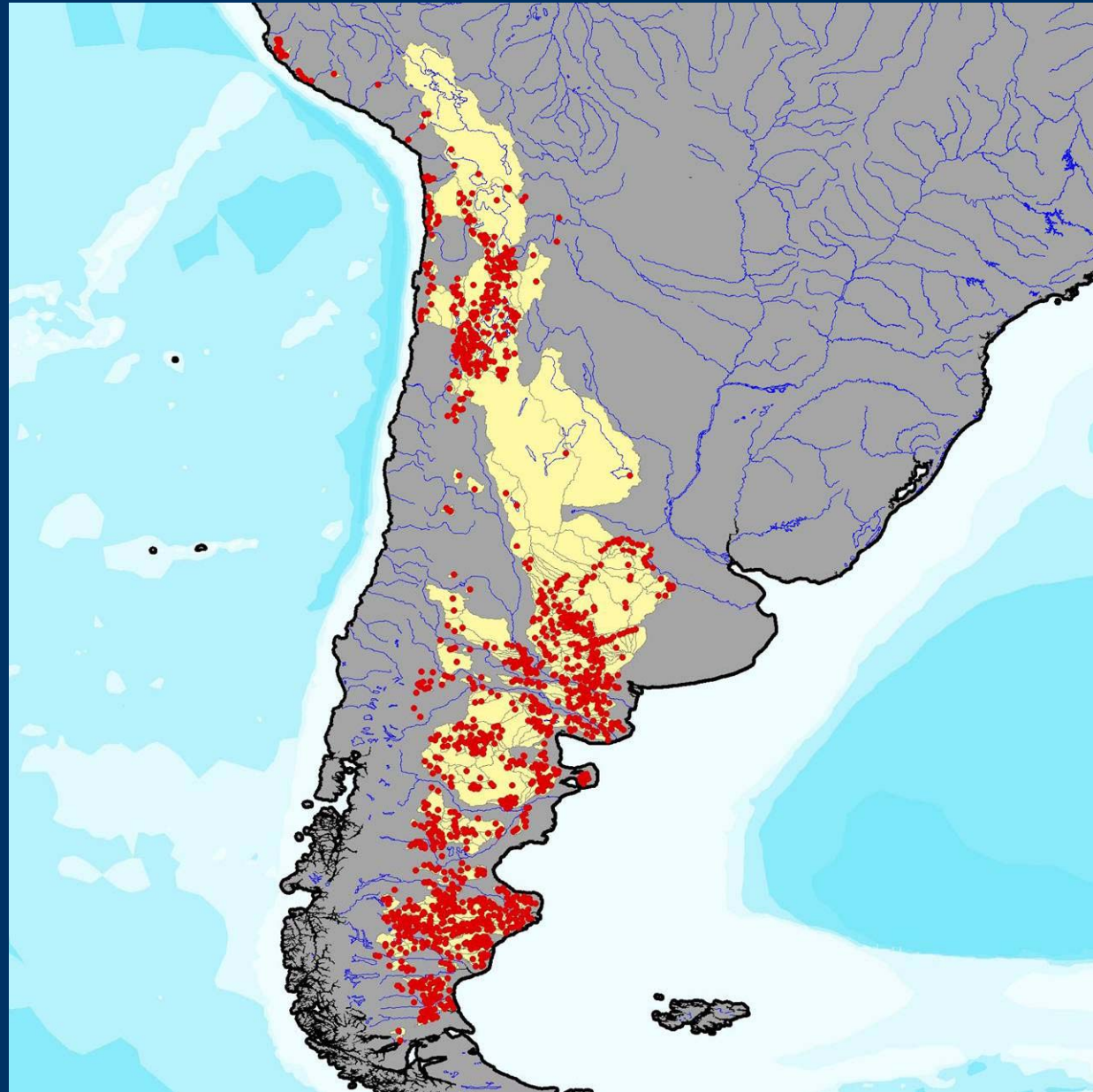
# Void filling





# Sink identification

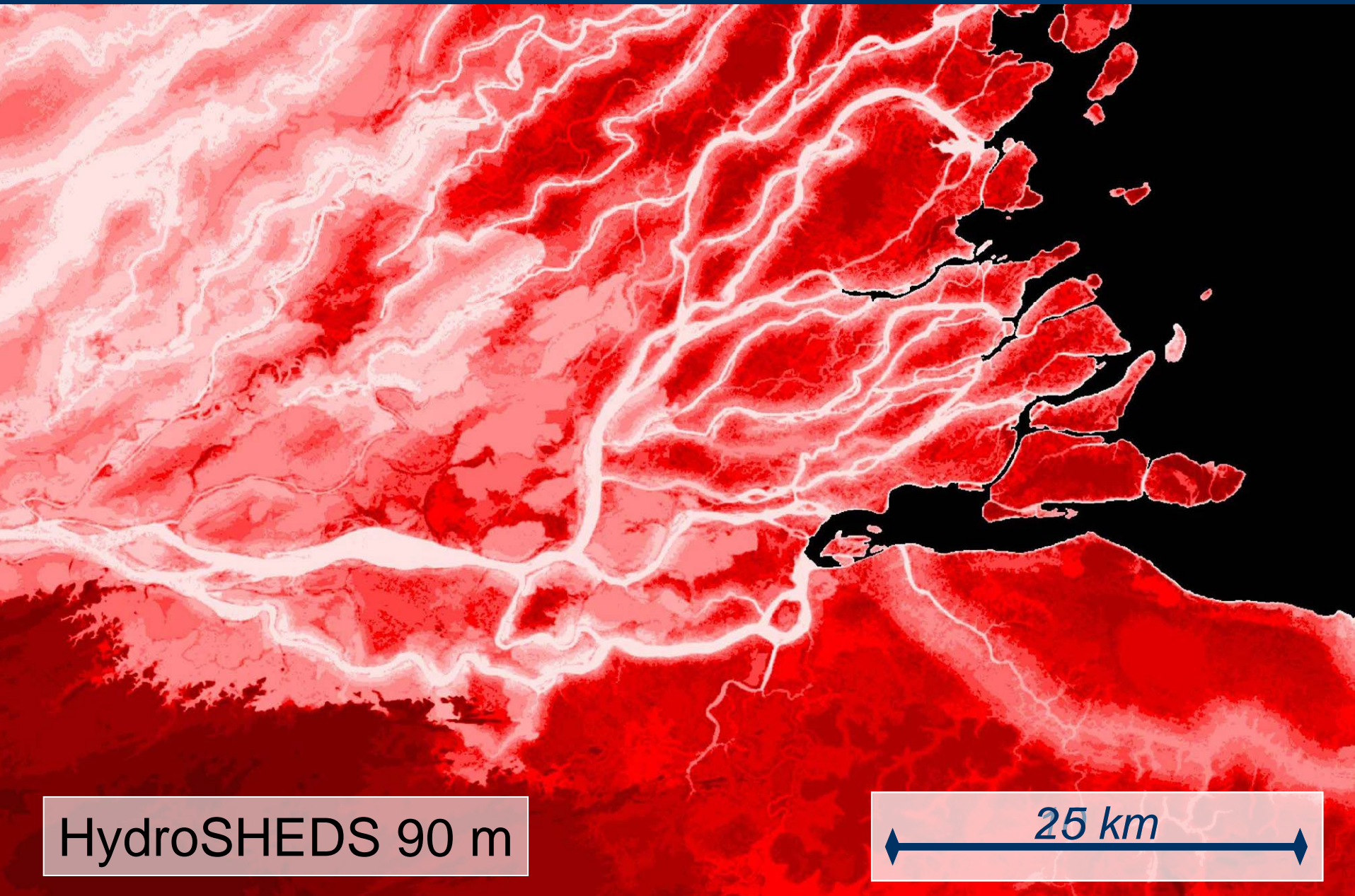
- Manual inspection
- GIS assisted





# Hydrological conditioning

- Lower all voids (JPL or USGS) and water bodies (NGA)  
(to force the flow into these potential open water surfaces)
- Filter the surface through directional 3x3 neighborhood analysis  
(to further remove spikes and wells)
- Carve valleys as identified through neighborhood terrain analysis  
(to remove small obstacles in valleys)
- Weed potential mangrove zones within coastal buffer zone  
(to avoid backwater effect)
- Burn rivers (ESRI 1:3 Mio.) & lakes (GLWD) into elevation surface  
(to emphasize most important lakes and river courses)
- Identify draft main river courses, cut through all “humps” along these rivers, and repeat all calculations  
(to remove dam/bridge/gorge effect)
- Introduce manual corrections (correct obvious errors, burn selected rivers from DCW 1:1 Mio.) and repeat calculations



HydroSHEDS 90 m

25 km

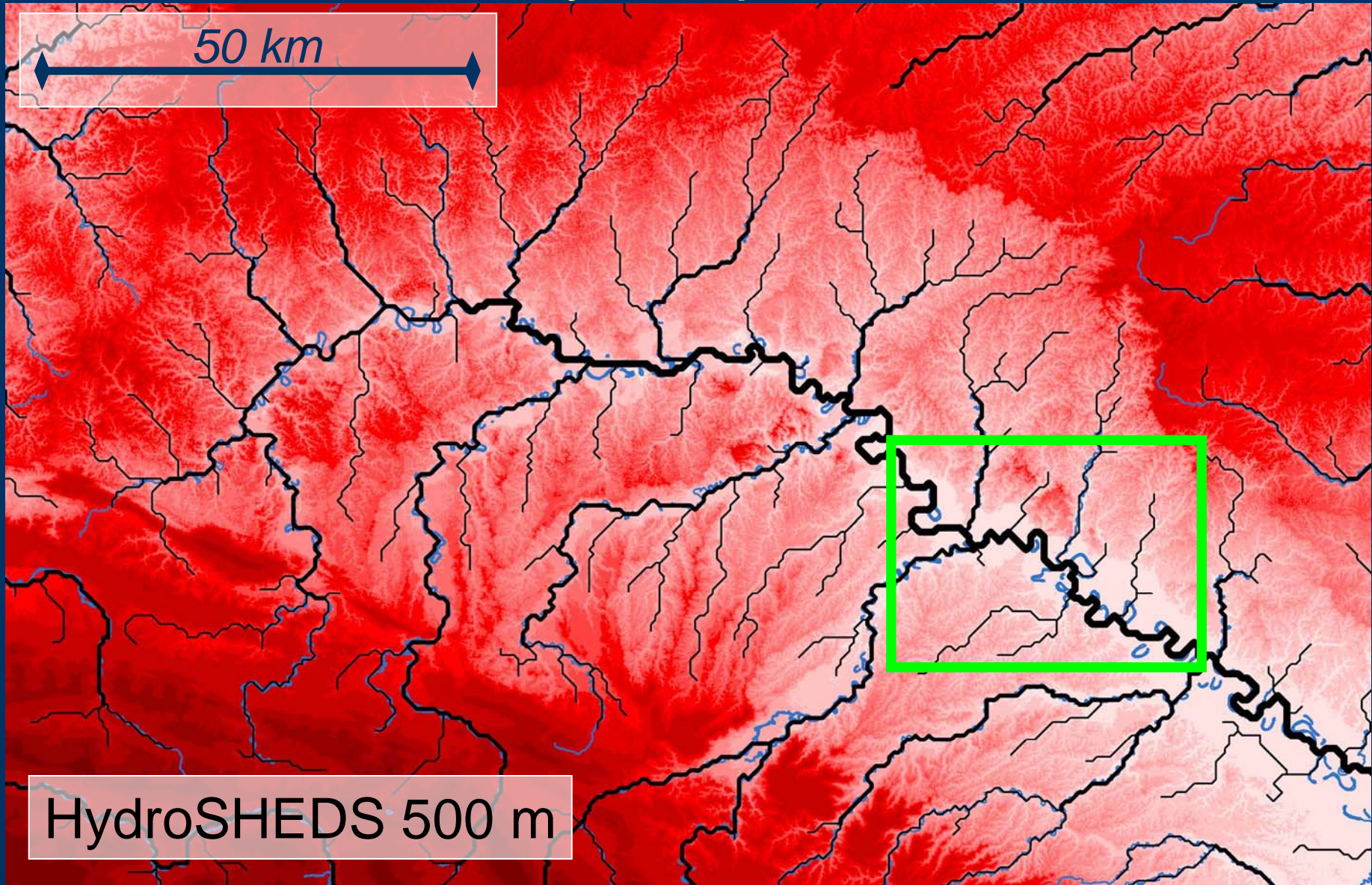


# Upscaling

- Identify all large river courses ( $> 100 \text{ km}^2$ ) at 90 m resolution
- Burn these rivers into hydrologically conditioned elevation data
- Upscale these elevation surfaces
- Calculate drainage direction map

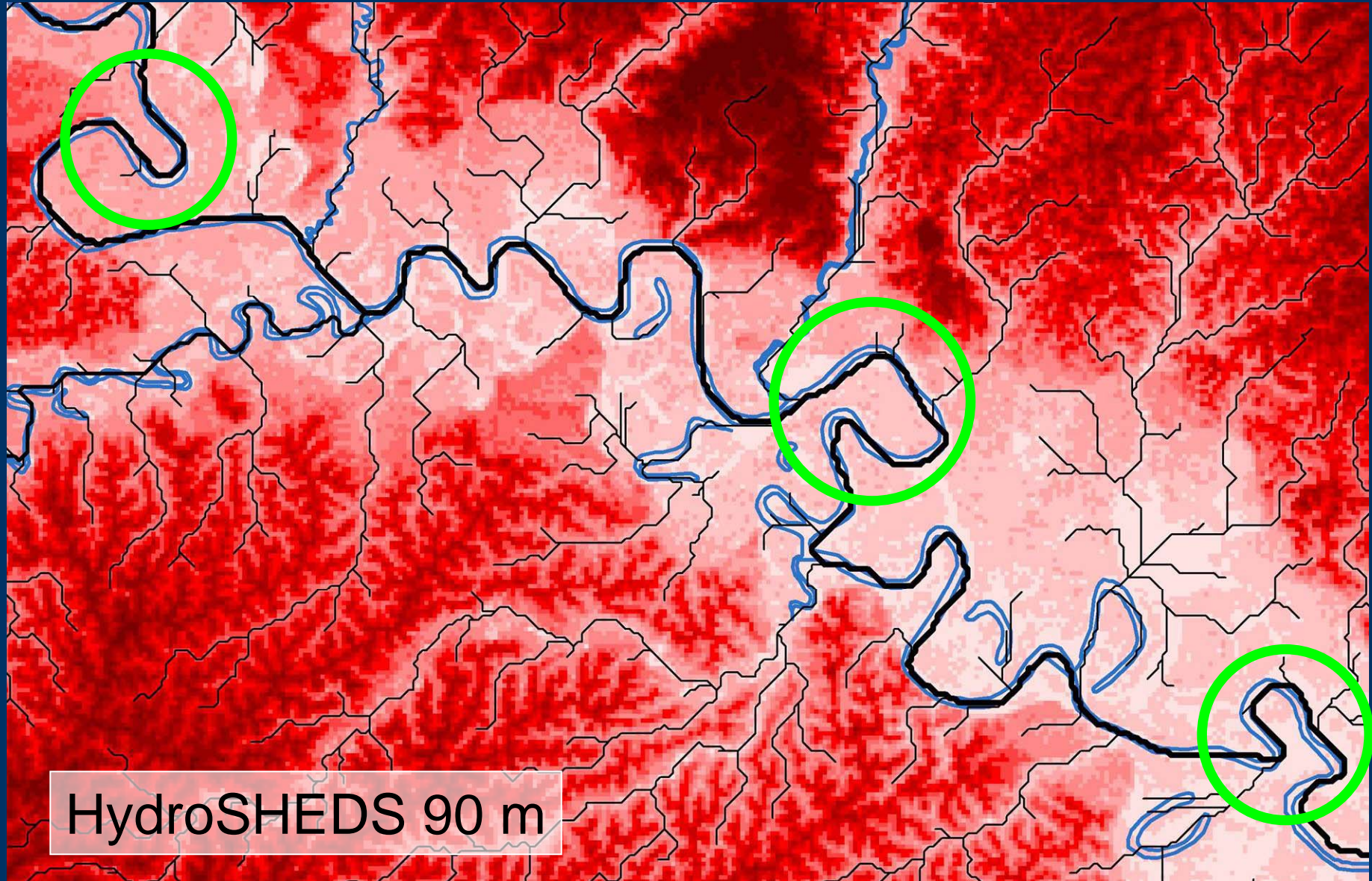


# Quality comparisons





# Quality comparisons



## Quality comparisons

- Improvement over Hydro1k
- Improvement over ESRI 1:3 Mio. rivers (because they are used in river burning)
- Comparison with DCW 1:1 Mio. depends on location, but mostly improvement
- Less accuracy than local river networks derived from high quality maps or remote sensing – But: HydroSHEDS is seamless and provides full topology information
- HydroSHEDS can be improved through incorporation of local scale information (e.g. high quality vectorized river maps)



## Main problems

- Vegetation (particularly in flat areas like large river floodplains)
- Rivers of about 90 m width with high riparian vegetation
- Roads in lowland vegetation (e.g. Amazon basin)
- Areas with low relief
- Braided rivers
- Sinks
- Coastal areas (mangroves, deltas)

## Introduction

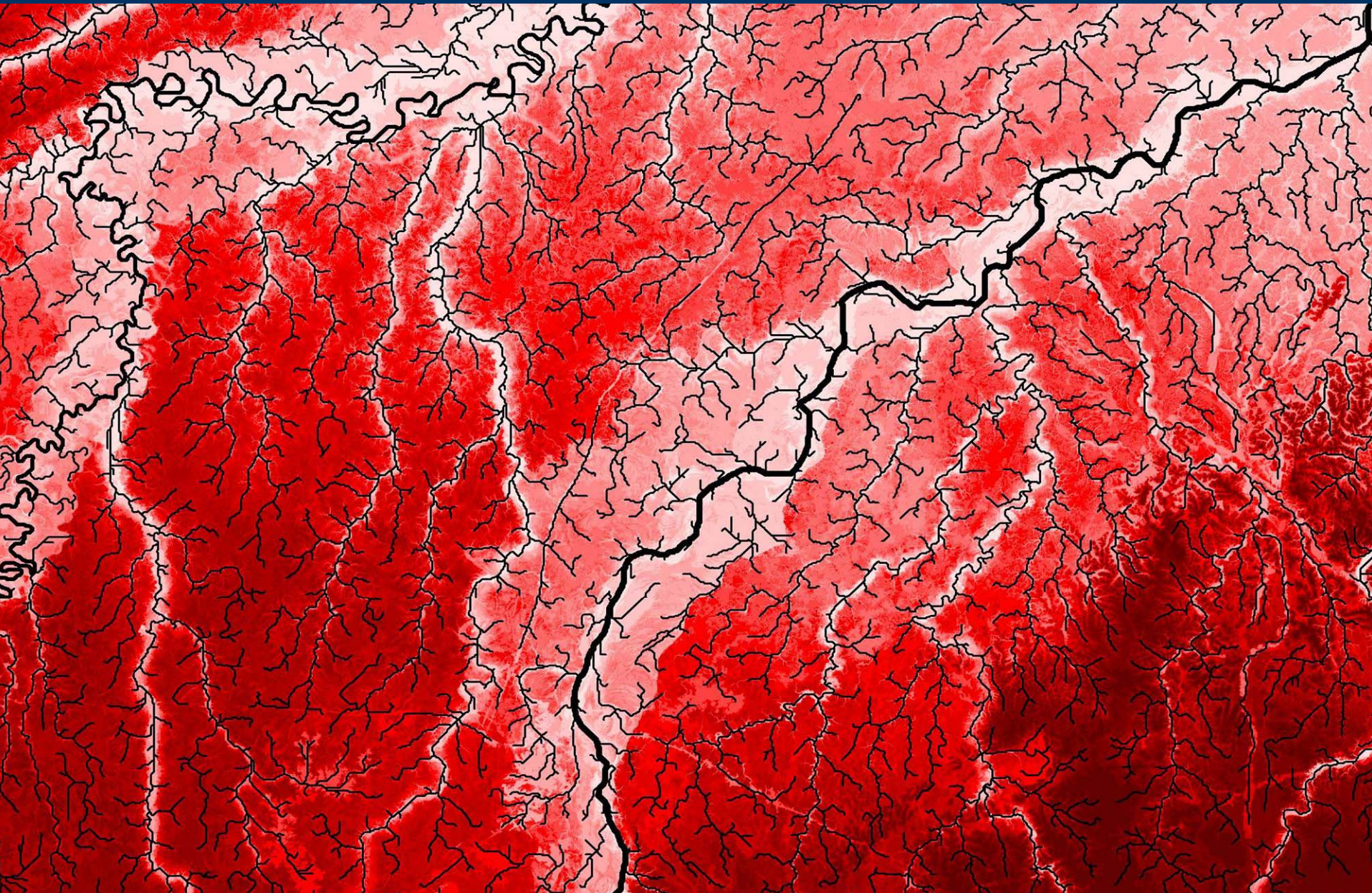
## Methods

## Results

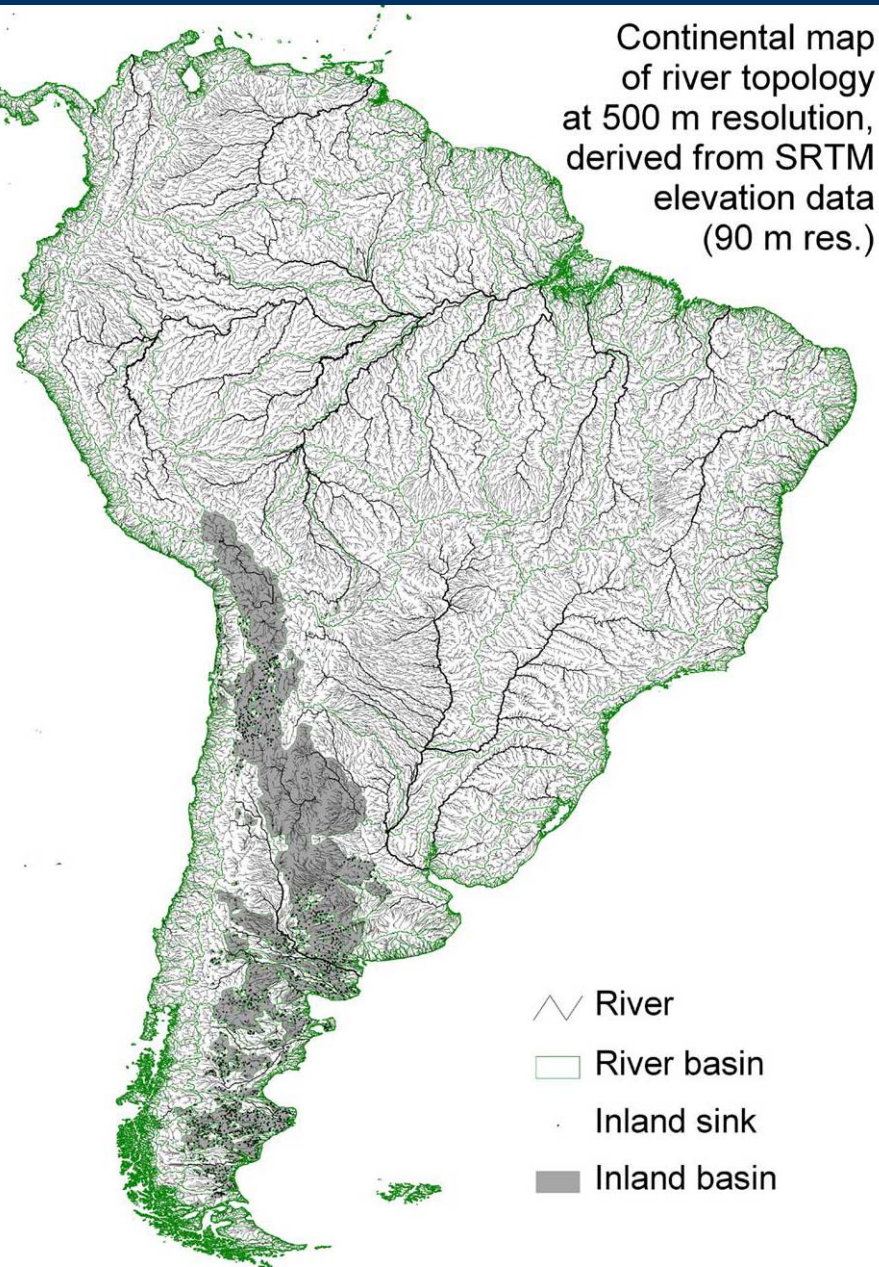
## Conclusions











# HydroSHEDS

- Hydrological data and maps  
 Provided by the Shuttle Elevation Derivatives at multiple Scales (SRTM3plus)
- 90 m (globally in 5-deg tiles)
  - 500 m (seamless continental)
  - 1 km (seamless global)
  - watershed boundaries
  - linear river reaches
  - flow directions
  - flow distances
  - slopes along rivers
- Derived products include:
- Free distribution online via USGS seamless server
- Timeline:
- planned: river topology
  - South America: available
  - planned: estimates of flow quantities
  - Global coverage: end 2005



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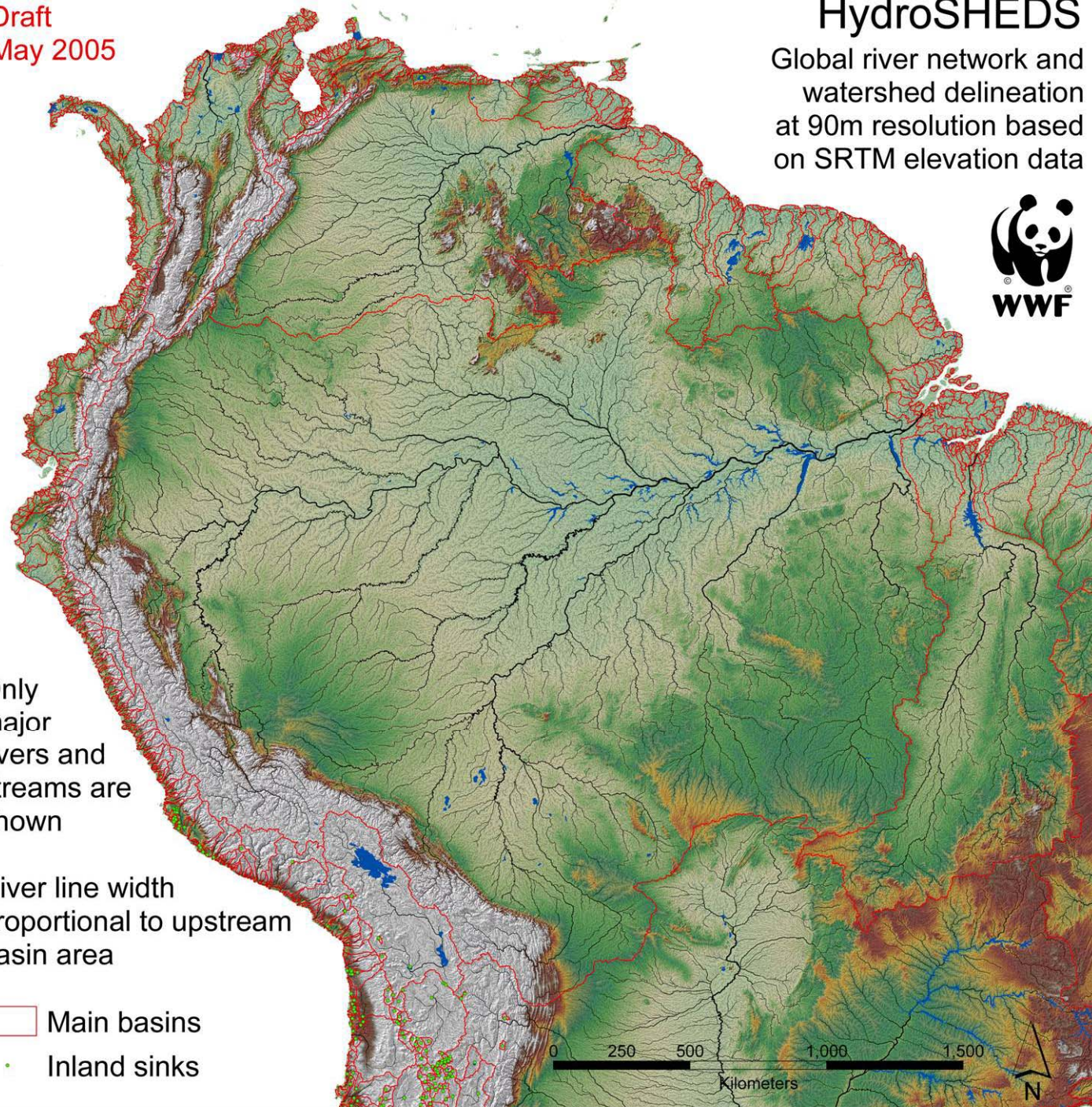


Thanks  
to all  
collaborators,  
data providers,  
the SC  
Johnson Fund,  
& the makers  
of SRTM

Only  
major  
rivers and  
streams are  
shown

River line width  
proportional to upstream  
basin area

□ Main basins  
• Inland sinks



You will soon find more  
information at

[www.worldwildlife.org/  
science/freshwater.cfm](http://www.worldwildlife.org/science/freshwater.cfm)